Sub D1 Cont'd

an inner pump electrode exposed to the gas mixture via the diffusion barrier, an outer pump electrode exposed to the gas mixture, and a solid electrolyte body arranged between the inner pump electrode and the outer pump electrode;

a joint supply conductor section through which the Nernst electrode and the inner pump electrode are connected to a circuit arrangement for controlling and evaluating the probe; and

a loaded voltage divider including a plurality of resistors that are arranged such that a negative feedback of a Nernst voltage circuit and of a pump voltage circuit is optimized, the plurality of resistors including a joint supply conductor resistor associated with the Nernst electrode and the inner pump electrode; wherein the negative feedback is optimized such that operation of the pump cell is not adversely affected.

REMARKS

After reviewing the Advisory Action of October 16, 2002, in which all pending claims were rejected under both the first and second paragraphs of 35 U.S.C. § 112, a telephone interview was conducted with the Examiner, who suggested that Applicants provide documentation showing the connectivity of the gas probe with an external amplifying device, so that the Examiner can better understand how the present invention "optimizes" or "maximizes" negative feedback. The Examiner has also indicated that it would also be helpful if Applicants explain how increasing the resistivity of the common conductor section increases the negative feedback of the external amplifying device.

Accordingly, Claim 6 has been amended to clarify the scope of terms "optimizes" and "maximizes." It is respectfully submitted that the amendments to claim 6 do not add new matter, have adequate support throughout the Specification, and put all claims in allowable condition.

Furthermore, the Specification has been amended herein to reflect the content of a proposed Figure 4, which illustrates a conventional connectivity between a Nernst gas probe and an

operational amplifier. Since it is believed that such connectivity is well known in the art, it is respectfully submitted that new Figure 4 and the amendments to the Specification do not add new matter. Accordingly, it is kindly requested that the proposed Figure 4 be entered.

I would agree

I. THE REJECTION OF CLAIMS 6-12 UNDER 35 U.S.C. § 112, FIRST PARAGRAPH

Claims 6-12 were rejected under 35 U.S.C. § 112, first paragraph. The Final Office Action contends that Applicants have only shown a configuration of resistors that connect the inner pumping electrode to the Nernst electrode, without describing the Nernst voltage circuitry or the pump voltage circuitry, which apparently utilize the configuration of resistors to achieve negative feedback.

As suggested by the Examiner, Applicants have submitted herewith a diagram (Figure 4) illustrating a conventional connectivity between a Nernst gas probe and an operational amplifier. As can be seen in the diagram, the Nernst voltage circuit is connected to the input of the operational amplifier, and the pump voltage circuit is connected to the output of the operational amplifier. As a result of the common supply lines of Nernst electrode 16 and inner pump electrode 38, the Nernst voltage circuit and the pump voltage circuit are electrically coupled, which may result in counterswings and overswings in voltage. By increasing resistor R3 (Figs. 2-3b), for example, an increase in negative feedback is achieved, which causes the output voltage of the operational amplifier to reduce, thereby reducing the counterswings and overswings in voltage. As the negative feedback to a conventional amplifier increases, the overall gain of the amplifier is reduced, thereby achieving a reduction in the amplitude of a ripple about lambda = 1, the ripple being caused by the Nernst voltage circuit and the pump voltage circuit being linked by a joint supply conductor.

Although increasing the negative feedback in this manner reduces the ripple about lambda = 1, the increased negative feedback disadvantageously causes the current supplied

to the pump cell to reduce. If this "pump current" is reduced below a certain minimum pump current, the pump cell may cease to operate correctly. Therefore, the requirements of the pump cell impose an upper limit on the negative feedback of the Nernst cell.

The loaded voltage divider recited in claim 6, for example, is designed to increase the negative feedback without causing the pump current to drop below the minimum pump current required to effectively operate the pump cell. In this manner, the resistors of the voltage divider may be fine-tuned to permit a maximum amount of negative feedback.

However, besides resistors R1, R2, and R3, the negative feedback and pump current of a pump cell are functions of various other complex factors, which prevent a manufacturer of the pump cell from freely choosing the resistors. These factors include, for example, the geometry of the pump cell, the thickness of the electrolyte used in the pump cell, the specific materials used, and the temperature of the pump cell. As a result, the manufacturer of the pump cell must engage in some trial and error to select the appropriate resistors R1, R2, and R3. For this purpose, the manufacturer may, for example, increase the resistance of the common conductor R3 by changing the cross section of R3, so that an output voltage U_p is reached, which is minimally sufficient for generating the pump current I_p.

For at least the foregoing reasons, Applicants kindly request that the rejection of claim 6 under 35 U.S.C. § 112, first paragraph, be withdrawn. Further, to the extent that claims 7-12 were rejected under 35 U.S.C. § 112, first paragraph, as being dependent upon claim 6, Applicants also kindly request that the rejection of these claims be withdrawn for at least the same reasons as discussed above with respect to claim 6.

II. THE REJECTION OF CLAIMS 6-12 UNDER 35 U.S.C. § 112, SECOND PARAGRAPH

As indicated in the Advisory Action, the Examiner has withdrawn the 35 U.S.C. § 112, second paragraph, rejections concerning whether the "joint supply conductor resistor" is part

of the loaded voltage divider, as recited in claim 6, and the objection to the term "directly," as recited in claim 12.

Otherwise, regarding claims 6-7, the Final Office Action asserts that the limitations drawn to the joint supply conductor are unclear because cooperation between the various components of the joint supply conductor and the Nernst and pump electrode are not clearly established. The Final Office Action contends that claim 6 vaguely specifies an arrangement of resistors to accomplish a vaguely defined function (i.e., "optimizing" or "maximizing" negative feedback).

Claim 6 has been amended herein to specifically recite that "the negative feedback is optimized such that operation of the pump cell is not adversely affected." Specifically, the loaded voltage divider recited in claims 6-7 increases the negative feedback without causing the pump current to drop below the minimum pump current required to effectively operate the pump cell. In this manner, the resistors of the voltage divider may be fine tuned to permit a maximum amount of negative feedback. Thus, it is clear what constitutes "optimized" or "maximized," i.e., "optimized" or "maximized" negative feedback may be accomplished by choosing the resistors of the voltage divider such that the negative feedback is as high as possible, without adversely affecting the pump cell. Since there is a definitive point at which the pump current becomes too low for effective operation of the pump cell, the metes and bounds of "optimized" and "maximized" are absolutely clear.

what definitive point

As regards claim 10, the Final Office Action asserts that it is unclear what the metes and bounds of the "minimized" cross section of the conductor section are. Specifically, the Final Office Action contends that the term "minimized" is not defined by the claims, and the Specification does not provide a standard for ascertaining the requisite degree of the term. Respectfully, Applicants disagree.

What is effective operation

Reducing the cross section is another way to increase the resistance value of the joint supply conductor section, which means reducing the cross section of the joint supply conductor

section is another way of increasing negative feedback between the Nernst voltage circuit and the pump voltage circuit. (Specification, page 3, lines 22-23). However, as explained above, as the negative feedback increases, the pump current supplied to the pump cell is reduced. If the pump current is reduced below a certain minimum pump current, the pump cell may cease to operate correctly. Therefore, the requirements of the pump cell impose an upper limit on the negative feedback of the Nernst cell, and as such, a minimum cross section for the joint supply conductor. Thus, the Specification clearly defines the metes and bounds of the term "minimized," as that term is used in claim 10.

This isn't minimized

As regards claim 11, the Final Office Action asserts that it is unclear how the specified printed conductor sections and contact point cooperate with the other specified elements of the invention, namely, the voltage divider resistors. Respectfully, Applicants disagree.

I'll drop this

In order for a claim to withstand scrutiny under 35 U.S.C. § 112, second paragraph, the claim must "set out and circumscribe a particular subject matter with a reasonable degree of clarity and particularity. [However, definiteness] of claim language must be analyzed, not in a vacuum, but in light of . . . [the] content of the particular application disclosure . . . ." MPEP 2173.02. The Specification clearly describes how the specified printed conductor sections and the contact point cooperate with the other specified elements, namely, the resistors of the voltage divider. Referring to Figure 2, for example, the detection voltage circuit (Nernst voltage circuit) and the pump voltage circuit are coupled to circuit arrangement 32 via the joint supply conductor of electrodes 16 and 38, respectively. In Figure 2, an equivalent circuit diagram illustrating how electrodes 16 and 38 are connected to circuit arrangement 32 is shown. It is clear from the equivalent circuit diagram that electrode 38 is initially connected to a contact point 52 via a printed conductor section 50. Electrode 16 is also connected to contact point 52 via a printed conductor section 54. (Specification, page 6, lines 14-19; Figure 2). Conductor

section 50 has an internal resistor R1, conductor section 54 has an internal resistor R2, and conductor section 54 has an internal resistor R3. Resistors R1, R2, and R3 form a loaded voltage divider, the constant current applied to Nernst measuring cell 12 flowing via conductor sections 54 and 56, while pump current I_P flows via conductor sections 50 and 56. (Specification, page 6, lines 25-28; Figure 2). Thus, it is clear how the specified printed conductor sections and contact point cooperate with the other specified elements of the invention.

As further regards claim 12, the Final Office Action asserts that it is unclear what the language drawn to a conductor section having a "maximum length" means. Respectfully, Applicants disagree.

Keep this though

Increasing the length of the joint supply conductor is another way to increase the resistance value of the joint supply conductor section, which means increasing the length of the joint supply conductor section is another way of increasing negative feedback between the Nernst voltage circuit and the pump voltage circuit. (Specification, page 7, lines 4-9). However, as explained above, as the negative feedback increases, the pump current supplied to the pump cell is reduced. If the pump current is reduced below a certain minimum pump current, the pump cell may cease to operate correctly. Therefore, the requirements of the pump cell impose an upper limit on the negative feedback of the Nernst cell, and as such, a maximum length for the joint supply conductor. Thus, the Specification clearly defines the metes and bounds of the term "maximized," as that term is used in claim 12.

For at least the foregoing reasons, Applicants respectfully request that the rejection of claims 6-12 under 35 U.S.C. § 112, second paragraph, be withdrawn.

III. CONCLUSION

In light of the foregoing, Applicants respectfully submit that pending claims 6-12 are in condition for allowance. Prompt reconsideration and allowance of the present application are therefore earnestly solicited.

Respectfully submitted,

KENYON & KENYON

Dated: January 2, 2003 By:

Richard L. Mayer
Reg. No. 22,490

(by R. No. 36,197)

CUSTOMER NO. 26646
PATENT & TRADEMARK OFFICE

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION:

The "Brief Description of the Drawings" section has been replaced with the following:

--Brief Description Of The Drawings

Figure 1 shows a section through the head of a probe.

Figure 2 shows an equivalent circuit diagram of a joint supply conductor of a Nernst electrode and an inner pump electrode of the probe.

Figure 3a shows one embodiment for influencing the resistances of the joint supply conductor according to Figure 2.

Figure 3b shows a second embodiment for influencing the resistances of the joint supply conductor according to Figure 2.

Figure 4 shows connectivity between a gas probe and an operational amplifier.--.

The paragraph beginning on page 2, line 25, has been replaced with the following:

--Referring to Figure 4, there is seen a conventional connectivity between a gas probe and an operational amplifier. In known probes, it is disadvantageous that because the supply conductor of the Nernst electrode and the inner pump electrode is shared, at least in some sections, their joint supply conductor resistor, which is not only part of the Nernst voltage circuit of the Nernst measuring cell but also part of the pump voltage circuit of the pump cell, causes coupling, which has an impact on lambda = 1 ripple. This minimizes the counterswings and overswings in voltage that may occur in the event of a jump

response in response to a transition from the rich range to the lean range.--.

<u>IN THE CLAIMS</u>:

Claim 6 has been amended without prejudice as follows:

6. (Twice Amended) A probe for determining an oxygen concentration in a gas mixture, comprising:

a Nernst measuring cell including:

a Nernst electrode exposed to the gas mixture to be measured via a diffusion barrier, a reference electrode exposed to a reference gas, and a solid electrolyte body arranged between the Nernst electrode and the reference electrode;

a pump cell including:

an inner pump electrode exposed to the gas mixture via the diffusion barrier, an outer pump electrode exposed to the gas mixture, and a solid electrolyte body arranged between the inner pump electrode and the outer pump electrode;

a joint supply conductor section through which the Nernst electrode and the inner pump electrode are connected to a circuit arrangement for controlling and evaluating the probe; and

a loaded voltage divider including a plurality of resistors that are arranged such that a negative feedback of a Nernst voltage circuit and of a pump voltage circuit is optimized, the plurality of resistors including a joint supply conductor resistor associated with the Nernst electrode and the inner pump electrode<u>;</u>

<u>wherein the negative feedback is optimized such that operation of the pump cell is not adversely affected</u>.